

# **MECHATRONICS BOOK SERIES SYSTEM DESIGN AND SIGNAL PROCESSING VOLUME 1**

---

## **Editors**

**Asan G. A. Muthalif  
Amir Akramin Shafie  
Siti Fauziah Toha  
Iskandar Al-Thani Mahmood**



**IIUM PRESS**

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

**MECHATRONICS BOOK SERIES:  
SYSTEM DESIGN AND SIGNAL  
PROCESSING - VOLUME 1**

---

**Editors**

Asan G. A. Muthalif  
Amir Akramin Shafie  
Siti Fauziah Toha  
Iskandar Al-Thani Mahmood



IIUM Press

Published by:  
IIUM Press  
International Islamic University Malaysia

First Edition, 2011  
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

ISBN: 978-967-418-173-4

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM  
(Malaysian Scholarly Publishing Council)

Printed by :  
**IIUM PRINTING SDN.BHD.**  
No. 1, Jalan Industri Batu Caves 1/3  
Taman Perindustrian Batu Caves  
Batu Caves Centre Point  
68100 Batu Caves  
Selangor Darul Ehsan  
Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543  
EMAIL: iiumprinting@yahoo.com

# CONTENTS

<b>Editorial Notes</b> .....	v
<b>About the Editors</b> .....	vi
<b>Contents</b> .....	vii
1 Energy Harvesting For Wide Area Sensor Networks.....	1
<i>Nahrul Khair Alang Md Rashid and Mohamad Ghazali Ameer Amsa</i>	
2 Design And Development Of Automatic Paper Box Folding Machine.....	8
<i>Md Mozasser Rahman, Anwar Hussain bin Mohamed Rasied and Ahmad Zulkamal Ismail</i>	
3 Intelligent Shoe Guard System.....	20
<i>M. J. E. Salami,, A. M. Aibinu, Siti Sarah binti Mohd Sufian</i>	
4 Applications of Mechatronics Engineering In Modern Agriculture.....	29
<i>Nahrul Khair Alang Md Rashid</i>	
5 Mathematical Modeling of Counter Flow Scrubber Using Eulerian-Lagrangian Approach.....	34
<i>Bashir Ahmed Danzomo and Momoh Jimoh E. Salami</i>	
6 Auto Landmarks Generation For SLAM Algorithm.....	42
<i>Nahrul Khair Alang Md Rashid and Imama Karim Manba Usama</i>	
7 Automatic Intelligent Ordering System Design and Tools Selection.....	46
<i>Siti Fauziah Toha and Rosdiazli Ibrahim</i>	
8 Design And Development of a Sorting Machine Using Multiple Sensory System.....	52
<i>Md Mozasser Rahman1, Siti Fatimah binti Abdul Rahim</i>	

9	Design And Development Of Intelligent Wiper For Vehicle Windshield: <b>Mechanical Design</b> .....	58
	<i>Shahrul Na'im Sidek, Abd Rahman Ibrahim</i>	
10	Design and Development of Intelligent Wiper for Vehicle Windshield: <b>Electrical Design</b> .....	63
	<i>Shahrul Na'im Sidek, Mohammad Afhamuddin Ab Aziz</i>	
11	Design and Development of Intelligent Wiper for Vehicle Windshield: Final Assembly And Results.....	68
	<i>Shahrul Na'im Sidek, Mohammad Afhamuddin Ab Aziz</i>	
12	Design and Prototyping of Inertia Wheel.....	73
	<i>W. Astuti, A. R. Kasim, M. I. Solihin, A.M. Aibinu, Momoh Jimoh E.Salami and Wahyudi</i>	
13	Design and Implementation of Instant Noodles Vending Machine.....	80
	<i>M.M.Rashid</i>	
14	Mathematical Model for Three Tank System.....	88
	<i>W. Astuti, R. Alimuddin, A.M. Aibinu, Momoh Jimoh E.Salami and Wahyudi Martono</i>	
15	Design of Software Tool to Detect QRS Complex from ECG Signal.....	98
	<i>Wahju Sediono</i>	
16	Development of a Jet Powered Floating Platform (In Air).....	104
	<i>M. Zharif, Raisuddin Khan and Masum Billah</i>	
17	Development of Experimental Station for Earthquake Prediction.....	109
	<i>A. M. Aibinu, M. J. E. Salami, Asan Gani Muthalif, Sumaiyah Mior Badri, Sarah Khalidah and Nuruleeman Saat</i>	
18	Development of Robotic Manipulator to Assist Human by Using Brain Signal.....	117
	<i>Rodhiah, Raisuddin Khan and Masum Billah</i>	
19	Development of Unmanned Aerial Vehicle – Part 1.....	123
	<i>Shahrul Na'im Sidek, M. Ismail Mohtar, A Mushawwir M Khalil</i>	

20	Development of Unmanned Aerial Vehicle – Part 2.....	129
	<i>Shahrul Na'im Sidek, A Mushawwir M Khalil, M. Ismail Mohtar</i>	
21	Earthquake Prediction And Monitoring Using Unusual Animal Behavior.....	134
	<i>A. M. Aibinu, W. Astuti, M. J. E. Salami, R. Akmelawati and Asan Gani Muthalif</i>	
22	Development of Automatic Rocking Baby Cradle.....	141
	<i>W. Astuti, N. F. Azlan, A.M. Aibinu, Momoh Jimoh E.Salami and Wahyudi Martono</i>	
23	Electrooculography (EOG)-Controlled Wheelchair.....	149
	<i>Shahrul Na'im Sidek, M. Iqbal Zakaria and A. Ridwan A.Aziz</i>	
24	Conceptual Design of an Intelligent Coconut Dehusking.....	155
	<i>M. J. E. Salami, A. M. Aibinu</i>	
25	An Electrooculogram (EOG) Signal for Wheelchair Motion Control.....	163
	<i>Salmiah Ahmad, Nurul Muthmainnah Mohd Noor</i>	
26	A conceptual Paper on Intelligent Car Battery Monitoring System.....	171
	<i>Abdul Hafiz Bin Sahar, Khairul Azhar Bin Muhamat, M. J. E. Salami, and A. M. Aibinu</i>	
27	GIS-Based Vehicle Traffic Simulation.....	177
	<i>Wahju Sediono</i>	
28	Intelligent Postal Mails Sorter.....	183
	<i>Mohd Arif Faiz Bin Omar, Mohd Zain Bin Ismail, M. J. E. Salami, A. M. Aibinu</i>	
29	Intelligent Wet Scrubber System for Industrial Air Pollution Control.....	188
	<i>Bashir Ahmed Danzomo and Momoh Jimoh E. Salami</i>	
30	Leveraging on Nature for Systems Design.....	194
	<i>Nahrul Khair Alang Md Rashid and Safinaz Kader Mohideen</i>	
31	Natural Ventilation of Yam Storage System.....	199
	<i>Murtala Abdulazeez, M.J.E. Salami, Md. Raisuddin Khan</i>	
32	Self-Repair Capability in Engineering Systems.....	208
	<i>Nahrul Khair Alang Md Rashid and Aous Naji Rasheed</i>	

33	Simulation of Airflow and Temperature Distribution in Yam Storage System	213
	<i>Murtala Abdulazeez, M.J.E. Salami, Md. Raisuddin Khan, Nabeel Adeyemi</i>	
34	Sound Identification in Noisy Environment.....	218
	<i>Nahrul Khair Alang Md Rashid, Nor Hidayati Diana Nordin and Alim Sabur Ajibola</i>	
35	Intelligent CCTV-Based Monitoring System for Kulliyah of Engineering, IIUM.....	225
	<i>M. J. E. Saslami,, A. M. Aibinu and Nur Syahrain binti Mohd Jahini</i>	
36	Virtual Modeling of Two-Wheeled Wheelchair using Msc Visual Nastran 4D.....	231
	<i>Salmiah Ahmad, M. O. Tokhi</i>	

## CHAPTER 36

### Virtual Modeling of Two-Wheeled Wheelchair using MSc Visual Nastran 4D

Salmiah Ahmad<sup>1, a</sup>, M. O. Tokhi<sup>2, b</sup>

<sup>1</sup>Department of Mechatronics Engineering, Kulliyah of Engineering, International Islamic University Malaysia, Jalan Gombak, 53100 Kuala Lumpur, Malaysia

<sup>2</sup>Department of Automatic Control and Systems Engineering, University of Sheffield, Mappin Street, S1 3JD, United Kingdom

<sup>a</sup>salmiah@iiium.edu.my, <sup>b</sup>o.tokhi@sheffield.ac.uk

#### 36.1 Introduction

Wheelchair on two wheels is a very complex, highly nonlinear system that has several complicated features to be modelled and controlled, [1]. A human has a significant mass when sitting on the wheelchair, thus the two-wheeled wheelchair is modelled with double links that mimic double inverted pendulum scenario. Therefore maintaining the nonlinear feature in two-wheeled wheelchair would be very much needed so that the approach may be easily implemented in practice. Therefore, a new wheelchair model is developed using four-dimension (4D) design software called MSC Visual Nastran 4D (VN). This modelling software can provide visualization showing the lifting, stabilizing as well as other wheelchair mobility features and has been used for many other applications, [2-5]. It is used to model the standard wheelchair and to integrate with MATLAB/Simulink for control purposes. The wheelchair model developed is used for designing and testing control strategies thus saving time, energy and financial cost before it is implemented at laboratory level or manufactured.

#### 36.2 MSC Visual Nastran 4D software

MSC Visual Nastran 4D (VN) is a powerful general purpose finite element analysis solution for small to complex assemblies. It combines several tasks in a user friendly environment involving computer-aided design (CAD), motion, finite element analysis (FEA), measurement as well as control. It provides a wide range of modelling and analysis capabilities, including linear static, displacement, strain, stress, vibration, heat transfer and more. Moreover, it can handle any material type from plastic and metal to composites and hyperelastic materials. It can be associated with most of the drawing tools such as Autodesk Inventor and Mechanical Desktop, Solid Edge and Solid Works. Some measurement capabilities of VN are, to measure forces, torques, friction, velocity and collisions using meters provided in the software environment. It can also determine vibration modes, buckling and heat transfer on a system modelled. The software is able to calculate loads and stresses of the assembly automatically. One of the specialties of VN is facilities of rendering and animation where simulation video can be captured and replayed at any time. Different camera locations can be used to obtain various angles of simulation. VN allows integration between the designed models with control strategies in MATLAB/Simulink environment; VN icon will appear in Simulink library tool box such that the model in VN is called using this icon. Input and output of the model in VN is defined using this icon, which can be seen as in Fig. 36.1.